

# Technical Documentation

## Sika AnchorFix<sup>®</sup> -2+ Arctic

### Product Information

Sika Services AG



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# SIKA ANCHORFIX®-2+ ARCTIC

## Chemical Resistance

The chemical mortar has undergone extensive chemical resistance testing. The results are summarised in the table below.

Chemical Environment	Concentration	Result
Aqueous Solution Acetic Acid	10%	✓
Acetone	100%	✗
Aqueous Solution Aluminium Chloride	Saturated	✓
Aqueous Solution Aluminium Nitrate	10%	✓
Ammonia Solution	5%	✓
Jet Fuel	100%	✓
Benzene	100%	✗
Benzoic Acid	Saturated	✓
Benzyl Alcohol	100%	✗
Sodium Hypochlorite Solution	5 - 15%	C
Butyl Alcohol	100%	C
Calcium Sulphate Aqueous Solution	Saturated	✓
Carbon Monoxide	Gas	✓
Carbon Tetrachloride	100%	✓
Chlorine Water	Saturated	✓
Chloro Benzene	100%	✗
Citric Acid Aqueous Solution	Saturated	✓
Cyclohexanol	100%	✓
Diesel Fuel	100%	✓
Diethylene Glycol	100%	✓
Ethanol	95%	C
Ethanol Aqueous Solution	20%	C
Heptane	100%	✓
Hexane	100%	C
Hydrochloric Acid	10%	✓
	15%	✓
	25%	C
Hydrogen Sulphide Gas	100%	✓
Isopropyl Alcohol	100%	C
Linseed Oil	100%	✓
Lubricating Oil	100%	✓
Mineral Oil	100%	✓
Paraffin / Kerosene (Domestic)	100%	✓
Phenol Aqueous Solution	1%	✗
Phosphoric Acid	50%	✓
Potassium Hydroxide	10% / pH13	C
Sea Water	100%	✓
Styrene	100%	✗
Sulphur Dioxide Solution	10%	✓
Sulphur Dioxide (40°C)	5%	✓

Sulphuric Acid	10%	✓
	50%	✓
Turpentine	100%	C
White Spirit	100%	✓
Xylene	100%	✗

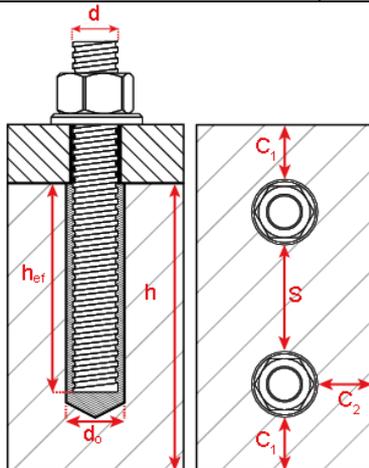
✓ = Resistant to 75°C with at least 80% of physical properties retained.

C = Contact only to a maximum of 25°C.

✗ = Not Resistant

## INSTALLATION PARAMETERS OF THREADED BARS

Size			M8	M10	M12	M16	M20	M24	M27	M30
Nominal drill hole diameter	$\varnothing d_0$	[mm]	10	12	14	18	22	26	30	35
Diameter of cleaning brush $d_b$	$d_b$	[mm]	14	14	20	20	29	29	40	40
Torque moment $T_{inst}$	$T_{inst}$	[Nm]	10	20	40	80	150	200	240	275
$h_{ef,min} = 8d$										
Depth of drill hole $h_0$	$h_0$	[mm]	64	80	96	128	160	192	216	240
Minimum edge distance $c_{min}$	$c_{min}$	[mm]	35	40	50	65	80	96	110	120
Minimum spacing $s_{min}$	$s_{min}$	[mm]	35	40	50	65	80	96	110	120
Minimum thickness of member $h_{min}$	$h_{min}$	[mm]	$h_{ef} + 30 \text{ mm} \geq 100 \text{ mm}$				$h_{ef} + 2d_0$			
$h_{ef,max} = 20d$										
Depth of drill hole $h_0$	$h_0$	[mm]	160	200	240	320	400	480	540	600
Minimum edge distance $c_{min}$	$c_{min}$	[mm]	80	100	120	160	200	240	270	300
Minimum spacing $s_{min}$	$s_{min}$	[mm]	80	100	120	160	200	240	270	300
Minimum thickness of member $h_{min}$	$h_{min}$	[mm]	$h_{ef} + 30 \text{ mm} \geq 100 \text{ mm}$				$h_{ef} + 2d_0$			



## INSTALLATION PARAMETERS OF REINFORCING BARS USED AS ANCHORS

Size			$\varnothing 8$	$\varnothing 10$	$\varnothing 12$	$\varnothing 16$	$\varnothing 20$	$\varnothing 25$	$\varnothing 32$	
Nominal drill hole diameter	$\varnothing d_0$	[mm]	12	14	16	20	25	32	40	
Diameter of cleaning brush $d_b$	$d_b$	[mm]	14	14	19	22	29	40	42	
$h_{ef,min} = 8d$										
Depth of drill hole $h_0$	$h_0$	[mm]	64	80	96	128	160	200	256	
Minimum edge distance $c_{min}$	$c_{min}$	[mm]	35	40	50	65	80	100	130	
Minimum spacing $s_{min}$	$s_{min}$	[mm]	35	40	50	65	80	100	130	

Minimum thickness of member $h_{min}$	$h_{min}$	[mm]	$h_{ef} + 30 \text{ mm} \geq 100 \text{ mm}$				$h_{ef} + 2d_0$		
$h_{ef,max} = 20d$									
Depth of drill hole $h_0$	$h_0$	[mm]	160	200	240	320	400	500	640
Minimum edge distance $c_{min}$	$c_{min}$	[mm]	80	100	120	160	200	250	320
Minimum spacing $s_{min}$	$s_{min}$	[mm]	80	100	120	160	200	250	320
Minimum thickness of member $h_{min}$	$h_{min}$	[mm]	$h_{ef} + 30 \text{ mm} \geq 100 \text{ mm}$				$h_{ef} + 2d_0$		

## THEORETICAL NUMBER OF FIXINGS PER CARTRIDGE

Applies to installations in solid substrates only

Cartridge Volume	$h_{ef}$	M8	M10	M12	M16	M20	M24
		Drilling $\varnothing$ 10mm	Drilling $\varnothing$ 12mm	Drilling $\varnothing$ 14mm	Drilling $\varnothing$ 18mm	Drilling $\varnothing$ 22mm	Drilling $\varnothing$ 26mm
410 ml	8d	148	91	60	32	19	12
	10d	118	72	48	26	15	9
	STD	118	81	52	32	17	11
	12d	98	60	40	21	12	8
300 ml	8d	106	65	43	23	13	8
	10d	85	52	34	18	11	7
	STD	85	58	38	23	12	8
	12d	71	43	29	15	9	5

*Note: Jobsite/contractor installations usually result in more resin being injected than the theoretical requirement resulting in lower number of fixings per cartridge. The reduction to the number of fixings per cartridge in practice is greater for smaller diameter holes and shallower embedment depths.*

# STEEL FAILURE INFORMATION - THREADED BARS

Characteristic resistance values to tension load

Steel Failure - Characteristic resistance										
Size			M8	M10	M12	M16	M20	M24	M27	M30
Steel grade 4.6	$N_{Rk,s}$	[kN]	15	23	34	63	98	141	184	224
Partial safety factor	$\gamma_{Ms}$	[-]	2							
Steel grade 5.8	$N_{Rk,s}$	[kN]	18	29	42	79	123	177	230	281
Partial safety factor	$\gamma_{Ms}$	[-]	1.5							
Steel grade 8.8	$N_{Rk,s}$	[kN]	29	46	67	126	196	282	367	449
Partial safety factor	$\gamma_{Ms}$	[-]	1.5							
Steel grade 10.9	$N_{Rk,s}$	[kN]	37	58	84	157	245	353	459	561
Partial safety factor	$\gamma_{Ms}$	[-]	1.4							
Stainless steel grade A4-70	$N_{Rk,s}$	[kN]	26	41	59	110	172	247	321	393
Partial safety factor	$\gamma_{Ms}$	[-]	1.9							
Stainless steel grade A4-80	$N_{Rk,s}$	[kN]	29	46	67	126	196	282	367	449
Partial safety factor	$\gamma_{Ms}$	[-]	1.6							
Stainless steel grade 1.4529	$N_{Rk,s}$	[kN]	26	41	59	110	172	247	321	393

## Characteristic resistance values to shear load

Steel Failure - without lever arm										
Size			M8	M10	M12	M16	M20	M24	M27	M30
Steel grade 4.8	$V_{Rk,s}$	[kN]	7	12	17	31	49	71	92	112
Partial safety factor	$\gamma_{Ms}$	[-]	1.67							
Steel grade 5.8	$V_{Rk,s}$	[kN]	9	15	21	39	61	88	115	140
Partial safety factor	$\gamma_{Ms}$	[-]	1.25							
Steel grade 8.8	$V_{Rk,s}$	[kN]	15	23	34	63	98	141	184	224
Partial safety factor	$\gamma_{Ms}$	[-]	1.25							
Steel grade 10.9	$V_{Rk,s}$	[kN]	18	29	42	79	123	177	230	281
Partial safety factor	$\gamma_{Ms}$	[-]	1.5							
Stainless steel grade A4-70	$V_{Rk,s}$	[kN]	13	20	30	55	86	124	161	196
Partial safety factor	$\gamma_{Ms}$	[-]	1.56							
Stainless steel grade A4-80	$V_{Rk,s}$	[kN]	15	23	34	63	98	141	184	224
Partial safety factor	$\gamma_{Ms}$	[-]	1.33							
Stainless steel grade 1.4529	$V_{Rk,s}$	[kN]	13	20	30	55	86	124	161	196
Partial safety factor	$\gamma_{Ms}$	[-]	1.25							

Steel Failure - with lever arm										
Size			M8	M10	M12	M16	M20	M24	M27	M30
Steel grade 4.8	$V_{Rk,s}$	[kN]	15	30	52	133	260	449	666	900
Partial safety factor	$\gamma_{Ms}$	[-]	1.67							
Steel grade 5.8	$V_{Rk,s}$	[kN]	19	37	66	166	325	561	832	1125
Partial safety factor	$\gamma_{Ms}$	[-]	1.25							
Steel grade 8.8	$V_{Rk,s}$	[kN]	30	60	105	266	519	898	1332	1799
Partial safety factor	$\gamma_{Ms}$	[-]	1.25							
Steel grade 10.9	$V_{Rk,s}$	[kN]	37	75	131	333	649	1123	1664	2249
Partial safety factor	$\gamma_{Ms}$	[-]	1.50							
Stainless steel grade A4-70	$V_{Rk,s}$	[kN]	26	52	92	233	454	786	1165	1574
Partial safety factor	$\gamma_{Ms}$	[-]	1.56							

Stainless steel grade A4-80	$V_{Rk,s}$	[kN]	30	60	105	266	519	898	1332	1799
Partial safety factor	$\gamma_{Ms}$	[-]	1.33							
Stainless steel grade 1.4529	$V_{Rk,s}$	[kN]	26	52	92	233	454	786	1165	1574
Partial safety factor	$\gamma_{Ms}$	[-]	1.25							
Concrete pryout failure										
Factor k from TR 029 Design of bonded anchors pt 5.2.3.3			2							
Partial safety factor	$\gamma_{Ms}$	[-]	1.5							

## USING SIKA ANCHORFIX<sup>®</sup>-2+ ARCTIC WITH THREADED BARS

Combined pullout and concrete cone failure in non-cracked concrete C20/25

Size			M8	M10	M12	M16	M20	M24	M27	M30	
Characteristic bond resistance in non-cracked concrete											
Characteristic bond resistance dry/wet concrete	$\tau_{Rk}$	[N/mm <sup>2</sup> ]	11	10	9.5	9.0	8.5	8.0	6.5	5.5	
Partial safety factor	$\gamma_{Mc}$	[-]	1.8						2.1		

## TENSION LOAD CALCULATIONS FOR COMBINED CONCRETE CONE & PULLOUT FAILURE AT VARIOUS EMBEDMENT DEPTHS

using threaded rods in dry / wet, uncracked, C20/25 concrete. Temperature range -40°C to +80°C.

Property	Symbol	Unit	Anchor Size							
			M8	M10	M12	M16	M20	M24	M27	M30
Effective Embedment Depth = 8d	$h_{ef}$	mm	64	80	96	128	160	192	216	240
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	17.69	25.13	34.38	57.91	85.45	115.81	119.09	124.41
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80	1.80	2.10	2.10
Effective Embedment Depth = 10d	$h_{ef}$	mm	80	100	120	160	200	240	270	300
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	22.12	31.42	42.98	72.38	106.81	144.76	148.86	155.51
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80	1.80	2.10	2.10
Effective Embedment Depth = STD	$h_{ef}$	mm	80	90	110	128	170	210	270	300
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	22.12	28.27	39.40	57.91	90.79	126.67	148.86	155.51
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80	1.80	2.10	2.10
Effective Embedment Depth = 12d	$h_{ef}$	mm	96	120	144	192	240	288	324	360
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	26.54	37.70	51.57	86.86	128.18	173.72	178.64	186.61
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80	1.80	2.10	2.10
Effective Embedment Depth = 14d	$h_{ef}$	mm	112	140	168	224	280	336	378	420
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	30.96	43.98	60.17	101.34	149.54	202.67	208.41	217.71
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80	1.80	2.10	2.10
Effective Embedment Depth = 16d	$h_{ef}$	mm	128	160	192	256	320	384	432	480
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	35.39	50.27	68.76	115.81	170.90	231.62	238.18	248.81
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80	1.80	2.10	2.10
Effective Embedment Depth = 18d	$h_{ef}$	mm	144	180	216	288	360	432	486	540

Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	39.81	56.55	77.36	130.29	192.27	260.58	267.96	279.92
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80	1.80	2.10	2.10
Effective Embedment Depth = 20d	$h_{ef}$	mm	160	200	240	320	400	480	540	600
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	44.23	62.83	85.95	144.76	213.63	289.53	297.73	311.02
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80	1.80	2.10	2.10

<sup>1.</sup> Characteristic loads are valid for combined concrete cone and pullout failure as defined by TR029 only. All other failure modes, including steel failure, detailed in TR029 as well as including combined effects of tension and shear, must be considered in accordance with TR029.

<sup>2.</sup> Characteristic loads are valid for single anchors without close edge, anchor spacing or eccentric loading considerations.

<sup>3.</sup> Tabulated values are valid for temperature range -40°C to +80°C (Max LTT = +50°C; Max STT = +80°C).

<sup>4.</sup> Tabulated values are only valid for the installation conditions stated. Other conditions, such as different temperature ranges, may affect the performance of the product.

<sup>5.</sup> Long term temperatures are those that remain roughly constant over prolonged periods. Short term temperatures occur over brief intervals, eg: diurnal cycling.

<sup>6.</sup> The compressive strength of the concrete ( $f_{ck,cube}$ ) is assumed to be 25 N/mm<sup>2</sup> for C20/25 concrete.

<sup>7.</sup> Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.

## TENSION LOAD CALCULATIONS FOR COMBINED CONCRETE CONE & PULLOUT FAILURE AT 8D EMBEDMENT DEPTH

using threaded rods in dry / wet, uncracked, C20/25 concrete. Temperature range -40°C to +80°C.

Property	Symbol	Unit	Anchor Size							
			M8	M10	M12	M16	M20	M24	M27	M30
Nominal Anchor Diameter	d	mm	8	10	12	16	20	24	27	30
Characteristic Bond Strength	$\tau_{Rk}$	N/mm <sup>2</sup>	11.00	10.00	9.50	9.00	8.50	8.00	6.50	5.50
Effective Embedment Depth	$h_{ef}$	mm	64	80	96	128	160	192	216	240
Characteristic Load (Combined Concrete Cone and Pullout Failure)	$N_{Rk,p}^0$	kN	17.69	25.13	34.38	57.91	85.45	115.81	119.09	124.41
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80	1.80	2.10	2.10
Characteristic Anchor Spacing (Splitting Failure)	$S_{cr,sp}$	mm	192	240	288	384	480	576	648	720
Characteristic Edge Distance (Splitting Failure)	$C_{cr,sp}$	mm	96	120	144	192	240	288	324	360
Characteristic Anchor Spacing (Combined Concrete Cone and Pullout Failure)	$S_{cr,Np}$	mm	192	231	270	351	426	496	503	514
Characteristic Edge Distance (Combined Concrete Cone and Pullout Failure)	$C_{cr,Np}$	mm	96	115	135	175	213	248	251	257

<sup>1.</sup> Characteristic loads are valid for combined concrete cone and pullout failure as defined by TR029 only. All other failure modes, including steel failure, detailed in TR029 as well as including combined effects of tension and shear, must be considered in accordance with TR029.

<sup>2.</sup> Characteristic loads are valid for single anchors without close edge, anchor spacing or eccentric loading considerations.

<sup>3.</sup> Tabulated values are valid for temperature range -40°C to +80°C (Max LTT = +50°C; Max STT = +80°C).

<sup>4.</sup> Tabulated values are only valid for the installation conditions stated. Other conditions, such as different temperature ranges, may affect the performance of the product.

<sup>5.</sup> Long term temperatures are those that remain roughly constant over prolonged periods. Short term temperatures occur over brief intervals, eg: diurnal cycling.

<sup>6.</sup> The compressive strength of the concrete ( $f_{ck,cube}$ ) is assumed to be 25 N/mm<sup>2</sup> for C20/25 concrete.

<sup>7.</sup> Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.

Reduction factors for close edge:

Combined concrete cone and pullout failure

Close Edge Distance, C (mm)	Anchor Size	Anchor Size								
		M8	M10	M12	M16	M20	M24	M27	M30	
35	0.55									
40	0.58	0.54								
50	0.65	0.59	0.56							
60	0.72	0.65	0.60							
65	0.76	0.68	0.63	0.56						
70	0.79	0.71	0.65	0.57						
80	0.87	0.77	0.70	0.61	0.56					
90	0.95	0.83	0.75	0.65	0.59					
96	N/R	0.87	0.78	0.67	0.61	0.57				
100		0.90	0.80	0.68	0.62	0.58				
110		0.96	0.86	0.72	0.65	0.60	0.60			
115		N/R	0.88	0.74	0.66	0.61	0.61			
120			0.91	0.76	0.68	0.63	0.62	0.62		
130			0.97	0.80	0.71	0.65	0.65	0.64		
135			N/R	0.82	0.73	0.67	0.66	0.65		
140				0.85	0.74	0.68	0.68	0.67		
150				0.89	0.78	0.71	0.70	0.69		
160				0.93	0.81	0.74	0.73	0.72		
170				0.98	0.84	0.76	0.76	0.75		
175				N/R	0.86	0.78	0.77	0.76		
180					0.88	0.79	0.78	0.77		
190					0.92	0.82	0.81	0.80		
200					0.95	0.85	0.84	0.83		
213					N/R	0.89	0.88	0.87		
220						0.91	0.90	0.89		
240						0.97	0.96	0.95		
248						N/R	0.99	0.97		
251							N/R	0.98		
257								N/R		

1. Tabulated values are only applicable for instances where combined concrete cone and pullout failure is the controlling failure mode as described by TR029. All other failure modes must be considered and different reduction factors may apply.
2. Tabulated values are based on a single anchor with a single close edge. Tabulated values must not be used if multiple close edges exist.
3. Anchors with geometry different to that defined in the above table must be considered separately and the tabulated values must not be used.
4. Interpolation is allowed.
5. Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.
6. Close edge distances must exceed or be equal to the minimum close edge distance ( $C_{min}$ ) as defined in the ETA.

Reduction factors for anchor spacing:

Combined concrete cone and pullout failure

Anchor Spacing Distance, S (mm)	Anchor Size	Anchor Size								
		M8	M10	M12	M16	M20	M24	M27	M30	
35	0.65									
40	0.66	0.65								
50	0.69	0.66	0.65							
60	0.71	0.68	0.66							
65	0.72	0.69	0.67	0.63						
70	0.73	0.70	0.68	0.64						
80	0.75	0.72	0.69	0.65	0.63					
90	0.78	0.74	0.71	0.67	0.64					
96	0.79	0.75	0.72	0.67	0.64	0.62				
100	0.80	0.76	0.73	0.68	0.65	0.63				
110	0.82	0.78	0.74	0.69	0.66	0.64	0.66			
120	0.84	0.80	0.76	0.70	0.67	0.65	0.67	0.68		
150	0.91	0.85	0.81	0.74	0.70	0.67	0.69	0.70		
192	N/R	0.93	0.88	0.80	0.75	0.71	0.73	0.74		
200		0.94	0.89	0.81	0.76	0.72	0.74	0.74		
231		N/R	0.94	0.85	0.79	0.75	0.76	0.77		
250			0.97	0.87	0.81	0.77	0.78	0.79		
270			N/R	0.90	0.83	0.79	0.80	0.80		
300				0.94	0.87	0.82	0.83	0.83		
351				N/R	0.92	0.86	0.87	0.87		
400					0.97	0.91	0.91	0.91		
426					N/R	0.94	0.93	0.93		
450						0.96	0.96	0.95		
496						N/R	0.99	0.99		
503							N/R	0.99		
514								N/R		

1. Tabulated values are only applicable for instances where combined concrete cone and pullout failure is the controlling failure mode as described by TR029. All other failure modes must be considered and different reduction factors may apply.
2. Tabulated values are based on a group of 2 anchors with the geometry defined by "S" and "Scr,Np" but without close edge considerations.
3. Anchors with geometry different to that defined in the above table must be considered separately and the tabulated values must not be used.
4. Interpolation is allowed.
5. Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.
6. Anchor spacing distances must exceed or be equal to the minimum anchor spacing ( $S_{min}$ ) as defined in the ETA.



# TENSION LOAD CALCULATIONS FOR COMBINED CONCRETE CONE & PULLOUT FAILURE AT STD EMBEDMENT DEPTH

using threaded rods in dry / wet, uncracked, C20/25 concrete. Temperature range -40°C to +80°C.

Property	Symbol	Unit	Anchor Size							
			M8	M10	M12	M16	M20	M24	M27	M30
Nominal Anchor Diameter	d	mm	8	10	12	16	20	24	27	30
Characteristic Bond Strength	$\tau_{Rk}$	N/mm <sup>2</sup>	11.00	10.00	9.50	9.00	8.50	8.00	6.50	5.50
Effective Embedment Depth	$h_{ef}$	mm	80	90	110	128	170	210	270	300
Characteristic Load (Combined Concrete Cone and Pullout Failure)	$N_{Rk,p}^0$	kN	22.12	28.27	39.40	57.91	90.79	126.67	148.86	155.51
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80	1.80	2.10	2.10
Characteristic Anchor Spacing (Splitting Failure)	$S_{cr,sp}$	mm	240	270	330	384	510	630	810	900
Characteristic Edge Distance (Splitting Failure)	$C_{cr,sp}$	mm	120	135	165	192	255	315	405	450
Characteristic Anchor Spacing (Combined Concrete Cone and Pullout Failure)	$S_{cr,Np}$	mm	194	231	270	351	426	496	503	514
Characteristic Edge Distance (Combined Concrete Cone and Pullout Failure)	$C_{cr,Np}$	mm	97	115	135	175	213	248	251	257

<sup>1</sup>: Characteristic loads are valid for combined concrete cone and pullout failure as defined by TR029 only. All other failure modes, including steel failure, detailed in TR029 as well 02

Reduction factors for close edge:  
Combined concrete cone and pullout failure

Close Edge Distance, C (mm)	Anchor Size	Anchor Size							
		M8	M10	M12	M16	M20	M24	M27	M30
40	0.58								
45	0.61	0.57							
50	0.65	0.59	0.56						
55	0.68	0.62	0.58						
60	0.72	0.65	0.60	0.54					
65	0.75	0.68	0.63	0.56					
70	0.79	0.71	0.65	0.57	0.53				
80	0.87	0.77	0.70	0.61	0.56				
85	0.90	0.80	0.72	0.63	0.57				
90	0.94	0.83	0.75	0.65	0.59	0.55			
97	N/R	0.88	0.79	0.67	0.61	0.57			
100		0.90	0.80	0.68	0.62	0.58			
105		0.93	0.83	0.70	0.63	0.59			
115		N/R	0.88	0.74	0.66	0.61			
135			N/R	0.82	0.73	0.67	0.66		
150				0.89	0.78	0.71	0.70	0.69	
175				N/R	0.86	0.78	0.77	0.76	
200					0.95	0.85	0.84	0.83	
213					N/R	0.89	0.88	0.87	
225						0.93	0.92	0.90	
248						N/R	0.99	0.97	
251							N/R	0.98	
257								N/R	

1. Tabulated values are only applicable for instances where combined concrete cone and pullout failure is the controlling failure mode as described by TR029. All other failure modes must be considered and different reduction factors may apply.
2. Tabulated values are based on a single anchor with a single close edge. Tabulated values must not be used if multiple close edges exist.
3. Anchors with geometry different to that defined in the above table must be considered separately and the tabulated values must not be used.
4. Interpolation is allowed.
5. Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.
6. Close edge distances must exceed or be equal to the minimum close edge distance ( $C_{min}$ ) as defined in the ETA.

Reduction factors for anchor spacing:  
Combined concrete cone and pullout failure

Anchor Spacing Distance, S (mm)	Anchor Size	Anchor Size							
		M8	M10	M12	M16	M20	M24	M27	M30
40	0.67								
45	0.68	0.66							
50	0.70	0.67							
55	0.71	0.68	0.66						
60	0.72	0.69	0.67						
65	0.73	0.70	0.68	0.63					
70	0.74	0.71	0.69	0.64					
80	0.76	0.73	0.70	0.65					
85	0.77	0.74	0.71	0.66	0.64				
90	0.78	0.75	0.72	0.67	0.64				
100	0.80	0.76	0.73	0.68	0.65				
105	0.81	0.77	0.74	0.69	0.66	0.64			
120	0.85	0.80	0.77	0.70	0.67	0.65			
135	0.88	0.83	0.79	0.72	0.69	0.67	0.69		
140	0.89	0.84	0.80	0.73	0.70	0.67	0.70		
150	0.91	0.86	0.81	0.74	0.71	0.68	0.70	0.71	
194	N/R	0.93	0.88	0.80	0.75	0.72	0.74	0.75	
200		0.95	0.89	0.81	0.76	0.73	0.75	0.75	
231		N/R	0.94	0.85	0.79	0.76	0.77	0.78	
250			0.97	0.87	0.81	0.77	0.79	0.79	
270			N/R	0.90	0.84	0.79	0.81	0.81	
300				0.94	0.87	0.82	0.83	0.83	
351				N/R	0.92	0.87	0.88	0.87	
400					0.97	0.91	0.92	0.91	
426					N/R	0.94	0.94	0.93	
450						0.96	0.96	0.95	
496						N/R	0.99	0.99	
503							N/R	0.99	
514								N/R	

1. Tabulated values are only applicable for instances where combined concrete cone and pullout failure is the controlling failure mode as described by TR029. All other failure modes must be considered and different reduction factors may apply.
2. Tabulated values are based on a group of 2 anchors with the geometry defined by "S" and " $S_{cr,Np}$ " but without close edge considerations.
3. Anchors with geometry different to that defined in the above table must be considered separately and the tabulated values must not be used.
4. Interpolation is allowed.
5. Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.
6. Anchor spacing distances must exceed or be equal to the minimum anchor spacing ( $S_{min}$ ) as defined in the ETA.



# TENSION LOAD CALCULATIONS FOR COMBINED CONCRETE CONE & PULLOUT FAILURE AT 20D EMBEDMENT DEPTH

using threaded rods in dry / wet, uncracked, C20/25 concrete. Temperature range -40°C to +80°C.

Property	Symbol	Unit	Anchor Size							
			M8	M10	M12	M16	M20	M24	M27	M30
Nominal Anchor Diameter	d	mm	8	10	12	16	20	24	27	30
Characteristic Bond Strength	$\tau_{Rk}$	N/mm <sup>2</sup>	11.00	10.00	9.50	9.00	8.50	8.00	6.50	5.50
Effective Embedment Depth	$h_{ef}$	mm	160	200	240	320	400	480	540	600
Characteristic Load (Combined Concrete Cone and Pullout Failure)	$N_{Rk,p}^0$	kN	44.23	62.83	85.95	144.76	213.63	289.53	297.73	311.02
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80	1.80	2.10	2.10
Characteristic Anchor Spacing (Splitting Failure)	$S_{cr,sp}$	mm	480	600	720	960	1200	1440	1620	1800
Characteristic Edge Distance (Splitting Failure)	$C_{cr,sp}$	mm	240	300	360	480	600	720	810	900
Characteristic Anchor Spacing (Combined Concrete Cone and Pullout Failure)	$S_{cr,Np}$	mm	194	231	270	351	426	496	503	514
Characteristic Edge Distance (Combined Concrete Cone and Pullout Failure)	$C_{cr,Np}$	mm	97	115	135	175	213	248	251	257

<sup>1.</sup> Characteristic loads are valid for combined concrete cone and pullout failure as defined by TR029 only. All other failure modes, including steel failure, detailed in TR029 as well as including combined effects of tension and shear, must be considered in accordance with TR029.

<sup>2.</sup> Characteristic loads are valid for single anchors without close edge, anchor spacing or eccentric loading considerations.

<sup>3.</sup> Tabulated values are valid for temperature range -40°C to +80°C (Max LTT = +50°C; Max STT = +80°C).

<sup>4.</sup> Tabulated values are only valid for the installation conditions stated. Other conditions, such as different temperature ranges, may affect the performance of the product.

<sup>5.</sup> Long term temperatures are those that remain roughly constant over prolonged periods. Short term temperatures occur over brief intervals, eg: diurnal cycling.

<sup>6.</sup> The compressive strength of the concrete ( $f_{ck,cube}$ ) is assumed to be 25 N/mm<sup>2</sup> for C20/25 concrete.

<sup>7.</sup> Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.

Reduction factors for close edge:  
Combined concrete cone and pullout failure

Close Edge Distance, C (mm)	Anchor Size	Anchor Size							
		M8	M10	M12	M16	M20	M24	M27	M30
80	0.87								
90	0.94								
97	N/R								
100		0.90							
115		N/R							
120			0.91						
130			0.97						
135			N/R						
140									
150									
160				0.93					
170				0.98					
175				N/R					
180									
190									
200					0.95				
213					N/R				
220									
240						0.97			
248						N/R			
251									
257									
260									
270							N/R		
280									
300									N/R

1. Tabulated values are only applicable for instances where combined concrete cone and pullout failure is the controlling failure mode as described by TR029. All other failure modes must be considered and different reduction factors may apply.
2. Tabulated values are based on a single anchor with a single close edge. Tabulated values must not be used if multiple close edges exist.
3. Anchors with geometry different to that defined in the above table must be considered separately and the tabulated values must not be used.
4. Interpolation is allowed.
5. Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.
6. Close edge distances must exceed or be equal to the minimum close edge distance ( $C_{min}$ ) as defined in the ETA.

Reduction factors for anchor spacing:  
Combined concrete cone and pullout failure

Anchor Spacing Distance, S (mm)	Anchor Size	Anchor Size							
		M8	M10	M12	M16	M20	M24	M27	M30
80	0.78								
90	0.80								
100	0.82	0.79							
120	0.86	0.82	0.79						
140	0.90	0.86	0.82						
160	0.94	0.89	0.85	0.79					
180	0.97	0.92	0.88	0.81					
194	N/R	0.94	0.90	0.83					
200		0.95	0.90	0.84	0.79				
220		0.98	0.93	0.86	0.81				
231		N/R	0.95	0.87	0.82				
240			0.96	0.88	0.83	0.80			
260			0.99	0.90	0.85	0.81			
270			N/R	0.91	0.86	0.82	0.83		
280				0.92	0.87	0.83	0.83		
300				0.95	0.89	0.85	0.85	0.85	
351				N/R	0.93	0.89	0.89	0.89	
400					0.98	0.93	0.92	0.92	
426					N/R	0.95	0.94	0.94	
450						0.96	0.96	0.96	
496						N/R	0.99	0.99	
503							N/R	0.99	
514									N/R

1. Tabulated values are only applicable for instances where combined concrete cone and pullout failure is the controlling failure mode as described by TR029. All other failure modes must be considered and different reduction factors may apply.
2. Tabulated values are based on a group of 2 anchors with the geometry defined by "S" and " $S_{cr, Np}$ " but without close edge considerations.
3. Anchors with geometry different to that defined in the above table must be considered separately and the tabulated values must not be used.
4. Interpolation is allowed.
5. Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.
6. Anchor spacing distances must exceed or be equal to the minimum anchor spacing ( $S_{min}$ ) as defined in the ETA.



# USING SIKA ANCHORFIX<sup>®</sup> -2+ ARCTIC WITH THREADED BARS

Combined pullout and concrete cone failure cracked concrete C20/25

Size	M10	M12	M16	M20	M24		
Characteristic bond resistance in non-cracked concrete							
Characteristic bond resistance dry/wet concrete	$\tau_{Rk}$	[N/mm <sup>2</sup> ]	5.0	5.0	5.0	4.5	4.5
Partial safety factor	$\gamma_{Mc}$	[-]	1.8				

## TENSION LOAD CALCULATIONS FOR COMBINED CONCRETE CONE & PULLOUT FAILURE AT VARIOUS EMBEDMENT DEPTHS

using threaded rods in dry / wet, cracked, C20/25 concrete. Temperature range -40°C to +80°C.

Property	Symbol	Unit	Anchor Size				
			M10	M12	M16	M20	M24
Effective Embedment Depth = 8d	$h_{ef}$	mm	80	96	128	160	192
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	12.57	18.10	32.17	45.24	65.14
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80
Effective Embedment Depth = 10d	$h_{ef}$	mm	100	120	160	200	240
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	15.71	22.62	40.21	56.55	81.43
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80
Effective Embedment Depth = STD	$h_{ef}$	mm	90	110	128	170	210
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	14.14	20.73	32.17	48.07	71.25
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80
Effective Embedment Depth = 12d	$h_{ef}$	mm	120	144	192	240	288
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	18.85	27.14	48.25	67.86	97.72
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80
Effective Embedment Depth = 14d	$h_{ef}$	mm	140	168	224	280	336
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	21.99	31.67	56.30	79.17	114.00
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80
Effective Embedment Depth = 16d	$h_{ef}$	mm	160	192	256	320	384
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	25.13	36.19	64.34	90.48	130.29
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80
Effective Embedment Depth = 18d	$h_{ef}$	mm	180	216	288	360	432
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	28.27	40.72	72.38	101.79	146.57
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80
Effective Embedment Depth = 20d	$h_{ef}$	mm	200	240	320	400	480
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	31.42	45.24	80.42	113.10	162.86
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80

<sup>1</sup> Characteristic loads are valid for combined concrete cone and pullout failure as defined by TR029 only. All other failure modes, including steel failure, detailed in TR029 as well as including combined effects of tension and shear, must be considered in accordance with TR029.

<sup>2</sup> Characteristic loads are valid for single anchors without close edge, anchor spacing or eccentric loading considerations.

<sup>3</sup> Tabulated values are valid for temperature range -40°C to +80°C (Max LTT = +50°C; Max STT = +80°C).

<sup>4</sup> Tabulated values are only valid for the installation conditions stated. Other conditions, such as different temperature ranges, may affect the performance of the product.

<sup>5</sup> Long term temperatures are those that remain roughly constant over prolonged periods. Short term temperatures occur over brief intervals, eg: diurnal cycling.

<sup>6</sup> The compressive strength of the concrete ( $f_{ck,cube}$ ) is assumed to be 25 N/mm<sup>2</sup> for C20/25 concrete.

<sup>7</sup> Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.

Technical Documentation

Sika AnchorFix-2+ Arctic

09 2016, 00

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English/Sika Services AG/Translation template

template for local adaption

# TENSION LOAD CALCULATIONS FOR COMBINED CONCRETE CONE & PULLOUT FAILURE AT 8D EMBEDMENT DEPTH

using threaded rods in dry / wet, cracked, C20/25 concrete. Temperature range -40°C to +80°C.

Property	Symbol	Unit	Anchor Size				
			M10	M12	M16	M20	M24
Nominal Anchor Diameter	d	mm	10	12	16	20	24
Characteristic Bond Strength	$\tau_{Rk}$	N/mm <sup>2</sup>	5.00	5.00	5.00	4.50	4.50
Effective Embedment Depth	$h_{ef}$	mm	80	96	128	160	192
Characteristic Load (Combined Concrete Cone and Pullout Failure)	$N_{Rk,p}^0$	kN	12.57	18.10	32.17	45.24	65.14
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80
Characteristic Anchor Spacing (Splitting Failure)	$S_{cr,sp}$	mm	240	288	384	480	576
Characteristic Edge Distance (Splitting Failure)	$C_{cr,sp}$	mm	120	144	192	240	288
Characteristic Anchor Spacing (Combined Concrete Cone and Pullout Failure)	$S_{cr,Np}$	mm	163	196	261	310	372
Characteristic Edge Distance (Combined Concrete Cone and Pullout Failure)	$C_{cr,Np}$	mm	82	98	131	155	186

<sup>1.</sup> Characteristic loads are valid for combined concrete cone and pullout failure as defined by TR029 only. All other failure modes, including steel failure, detailed in TR029 as well as including combined effects of tension and shear, must be considered in accordance with TR029.

<sup>2.</sup> Characteristic loads are valid for single anchors without close edge, anchor spacing or eccentric loading considerations.

<sup>3.</sup> Tabulated values are valid for temperature range -40°C to +80°C (Max LTT = +50°C; Max STT = +80°C).

<sup>4.</sup> Tabulated values are only valid for the installation conditions stated. Other conditions, such as different temperature ranges, may affect the performance of the product.

<sup>5.</sup> Long term temperatures are those that remain roughly constant over prolonged periods. Short term temperatures occur over brief intervals, eg: diurnal cycling.

<sup>6.</sup> The compressive strength of the concrete ( $f_{ck,cube}$ ) is assumed to be 25 N/mm<sup>2</sup> for C20/25 concrete.

<sup>7.</sup> Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.

Reduction factors for close edge:  
Combined concrete cone and pullout failure

Close Edge Distance, C (mm)	Anchor Size	Anchor Size				
		M10	M12	M16	M20	M24
40	0.63					
50	0.71	0.64				
60	0.80	0.71				
65	0.84	0.75	0.64			
70	0.89	0.78	0.66			
80	0.98	0.86	0.71	0.65		
90	N/R	0.87	0.72	0.66		
96		0.94	0.77	0.69	0.65	
100		0.98	0.80	0.72	0.66	
110		N/R	0.81	0.73	0.66	
115			0.82	0.74	0.70	
120			0.88	0.78	0.74	
130			0.94	0.83	0.78	
135			N/R	0.88	0.81	
140				0.92	0.85	
150				0.97	0.87	
160				N/R	0.89	
170					0.93	
175					0.97	
180					N/R	
190						
200						
213						
220						
240						
248						
251						
257						

1. Tabulated values are only applicable for instances where combined concrete cone and pullout failure is the controlling failure mode as described by TR029. All other failure modes must be considered and different reduction factors may apply.
2. Tabulated values are based on a single anchor with a single close edge. Tabulated values must not be used if multiple close edges exist.
3. Anchors with geometry different to that defined in the above table must be considered separately and the tabulated values must not be used.
4. Interpolation is allowed.
5. Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.
6. Close edge distances must exceed or be equal to the minimum close edge distance ( $C_{min}$ ) as defined in the ETA.

Reduction factors for anchor spacing:  
Combined concrete cone and pullout failure

Anchor Spacing Distance, S (mm)	Anchor Size	Anchor Size				
		M10	M12	M16	M20	M24
40	0.71					
50	0.73	0.71				
60	0.76	0.73				
65	0.77	0.74	0.69			
70	0.78	0.75	0.70			
80	0.81	0.77	0.72	0.69		
90	0.83	0.79	0.73	0.71		
96	0.84	0.80	0.74	0.72	0.69	
100	0.85	0.81	0.75	0.72	0.69	
120	0.90	0.85	0.78	0.75	0.71	
140	0.95	0.89	0.81	0.78	0.74	
160	0.99	0.93	0.84	0.80	0.76	
163	N/R	0.94	0.85	0.81	0.76	
180		0.97	0.88	0.83	0.78	
196		N/R	0.90	0.85	0.80	
200			0.91	0.86	0.81	
220			0.94	0.88	0.83	
240			0.97	0.91	0.85	
261			N/R	0.94	0.88	
280				0.96	0.90	
300				0.99	0.92	
310				N/R	0.93	
320					0.94	
340					0.96	
360					0.99	
372					N/R	

1. Tabulated values are only applicable for instances where combined concrete cone and pullout failure is the controlling failure mode as described by TR029. All other failure modes must be considered and different reduction factors may apply.
2. Tabulated values are based on a group of 2 anchors with the geometry defined by "S" and "S<sub>cr, Np</sub>" but without close edge considerations.
3. Anchors with geometry different to that defined in the above table must be considered separately and the tabulated values must not be used.
4. Interpolation is allowed.
5. Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.
6. Anchor spacing distances must exceed or be equal to the minimum anchor spacing ( $S_{min}$ ) as defined in the ETA.

# TENSION LOAD CALCULATIONS FOR COMBINED CONCRETE CONE & PULLOUT FAILURE AT STD EMBEDMENT DEPTH

using threaded rods in dry / wet, cracked, C20/25 concrete. Temperature range -40°C to +80°C.

Property	Symbol	Unit	Anchor Size				
			M10	M12	M16	M20	M24
Nominal Anchor Diameter	d	mm	10	12	16	20	24
Characteristic Bond Strength	$\tau_{RK}$	N/mm <sup>2</sup>	5.00	5.00	5.00	4.50	4.50
Effective Embedment Depth	$h_{ef}$	mm	90	110	128	170	210
Characteristic Load (Combined Concrete Cone and Pullout Failure)	$N_{RK,p}^0$	kN	14.14	20.73	32.17	48.07	71.25
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80
Characteristic Anchor Spacing (Splitting Failure)	$S_{cr,sp}$	mm	270	330	384	510	630
Characteristic Edge Distance (Splitting Failure)	$C_{cr,sp}$	mm	135	165	192	255	315
Characteristic Anchor Spacing (Combined Concrete Cone and Pullout Failure)	$S_{cr,Np}$	mm	163	196	261	310	372
Characteristic Edge Distance (Combined Concrete Cone and Pullout Failure)	$C_{cr,Np}$	mm	82	98	131	155	186

1. Characteristic loads are valid for combined concrete cone and pullout failure as defined by TR029 only. All other failure modes, including steel failure, detailed in TR029 as well as including combined effects of tension and shear, must be considered in accordance with TR029.

2. Characteristic loads are valid for single anchors without close edge, anchor spacing or eccentric loading considerations.

3. Tabulated values are valid for temperature range -40°C to +80°C (Max LTT = +50°C; Max STT = +80°C).

4. Tabulated values are only valid for the installation conditions stated. Other conditions, such as different temperature ranges, may affect the performance of the product.

5. Long term temperatures are those that remain roughly constant over prolonged periods. Short term temperatures occur over brief intervals, eg: diurnal cycling.

6. The compressive strength of the concrete ( $f_{ck,cube}$ ) is assumed to be 25 N/mm<sup>2</sup> for C20/25 concrete.

7. Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.

Reduction factors for anchor spacing:  
Combined concrete cone and pullout failure

	Anchor Spacing Distance, S (mm)	Anchor Size				
		M10	M12	M16	M20	M24
	45	0.72				
	50	0.74				
	55	0.75	0.72			
	60	0.76	0.73			
	65	0.77	0.74	0.69		
	70	0.78	0.75	0.70		
	80	0.81	0.77	0.72		
	90	0.83	0.79	0.73	0.71	
	100	0.86	0.81	0.75	0.72	
	105	0.87	0.82	0.76	0.73	0.70
	120	0.90	0.85	0.78	0.75	0.72
	140	0.95	0.89	0.81	0.78	0.74
	160	0.99	0.93	0.84	0.81	0.76
	163	N/R	0.94	0.85	0.81	0.77
	180		0.97	0.88	0.83	0.79
	196		N/R	0.90	0.85	0.80
	200			0.91	0.86	0.81
	220			0.94	0.88	0.83
	240			0.97	0.91	0.85
	261			N/R	0.94	0.88
	280				0.96	0.90
	300				0.99	0.92
	310				N/R	0.93
	320					0.94
	340					0.97
	360					0.99
	372					N/R

1. Tabulated values are only applicable for instances where combined concrete cone and pullout failure is the controlling failure mode as described by TR029. All other failure modes must be considered and different reduction factors may apply.
2. Tabulated values are based on a single anchor with a single close edge. Tabulated values must not be used if multiple close edges exist.
3. Anchors with geometry different to that defined in the above table must be considered separately and the tabulated values must not be used.
4. Interpolation is allowed.
5. Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.
6. Close edge distances must exceed or be equal to the minimum close edge distance ( $C_{min}$ ) as defined in the ETA.

Reduction factors for close edge:  
Combined concrete cone and pullout failure

	Close Edge Distance, C (mm)	Anchor Size				
		M10	M12	M16	M20	M24
	45	0.67				
	50	0.71				
	55	0.75	0.68			
	60	0.80	0.71			
	65	0.84	0.75	0.64		
	70	0.89	0.78	0.66		
	80	0.98	0.86	0.71		
	82	N/R	0.87	0.72		
	85		0.90	0.74	0.67	
	90		0.94	0.77	0.69	
	98		N/R	0.81	0.73	
	100			0.82	0.74	
	105			0.85	0.76	0.68
	110			0.88	0.78	0.70
	120			0.94	0.83	0.74
	131			N/R	0.88	0.78
	140				0.92	0.81
	150				0.97	0.85
	155				N/R	0.87
	160					0.89
	170					0.93
	180					0.97
	186					N/R

1. Tabulated values are only applicable for instances where combined concrete cone and pullout failure is the controlling failure mode as described by TR029. All other failure modes must be considered and different reduction factors may apply.
2. Tabulated values are based on a group of 2 anchors with the geometry defined by "S" and "S<sub>cr,Np</sub>" but without close edge considerations.
3. Anchors with geometry different to that defined in the above table must be considered separately and the tabulated values must not be used.
4. Interpolation is allowed.
5. Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.
6. Anchor spacing distances must exceed or be equal to the minimum anchor spacing ( $S_{min}$ ) as defined in the ETA.

# TENSION LOAD CALCULATIONS FOR COMBINED CONCRETE CONE & PULLOUT FAILURE AT 20D EMBEDMENT DEPTH

using threaded rods in dry / wet, cracked, C20/25 concrete. Temperature range -40°C to +80°C.

Property	Symbol	Unit	Anchor Size				
			M10	M12	M16	M20	M24
Nominal Anchor Diameter	d	mm	10	12	16	20	24
Characteristic Bond Strength	$\tau_{Rk}$	N/mm <sup>2</sup>	5.00	5.00	5.00	4.50	4.50
Effective Embedment Depth	$h_{ef}$	mm	200	240	320	400	480
Characteristic Load (Combined Concrete Cone and Pullout Failure)	$N_{Rk,p}^0$	kN	31.42	45.24	80.42	113.10	162.86
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80
Characteristic Anchor Spacing (Splitting Failure)	$S_{cr,sp}$	mm	600	720	960	1200	1440
Characteristic Edge Distance (Splitting Failure)	$C_{cr,sp}$	mm	300	360	480	600	720
Characteristic Anchor Spacing (Combined Concrete Cone and Pullout Failure)	$S_{cr,Np}$	mm	163	196	261	310	372
Characteristic Edge Distance (Combined Concrete Cone and Pullout Failure)	$C_{cr,Np}$	mm	82	98	131	155	186

<sup>1.</sup> Characteristic loads are valid for combined concrete cone and pullout failure as defined by TR029 only. All other failure modes, including steel failure, detailed in TR029 as well as including combined effects of tension and shear, must be considered in accordance with TR029.

<sup>2.</sup> Characteristic loads are valid for single anchors without close edge, anchor spacing or eccentric loading considerations.

<sup>3.</sup> Tabulated values are valid for temperature range -40°C to +80°C (Max LTT = +50°C; Max STT = +80°C).

<sup>4.</sup> Tabulated values are only valid for the installation conditions stated. Other conditions, such as different temperature ranges, may affect the performance of the product.

<sup>5.</sup> Long term temperatures are those that remain roughly constant over prolonged periods. Short term temperatures occur over brief intervals, eg: diurnal cycling.

<sup>6.</sup> The compressive strength of the concrete ( $f_{ck,cube}$ ) is assumed to be 25 N/mm<sup>2</sup> for C20/25 concrete.

<sup>7.</sup> Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.

Reduction factors for anchor spacing:  
Combined concrete cone and pullout failure

Anchor Spacing Distance, S (mm)	Anchor Size	Anchor Size				
		M10	M12	M16	M20	M24
100	0.87					
110	0.89					
120	0.91	0.86				
130	0.93	0.88				
140	0.95	0.90				
150	0.97	0.92				
160	0.99	0.94	0.86			
163	N/R	0.94	0.87			
170		0.96	0.88			
180		0.97	0.89			
190		0.99	0.90			
196		N/R	0.91			
200			0.92	0.87		
220			0.94	0.90		
240			0.97	0.92	0.87	
261			N/R	0.94	0.89	
280				0.97	0.91	
300				0.99	0.93	
310				N/R	0.94	
320					0.95	
340					0.97	
360					0.99	
372						N/R

Reduction factors for close edge:  
Combined concrete cone and pullout failure

Close Edge Distance, C (mm)	Anchor Size	Anchor Size				
		M10	M12	M16	M20	M24
100	N/R					
110						
120		N/R				
130						
140						
160				N/R		
180						
200					N/R	
220						
240						N/R

1. Tabulated values are only applicable for instances where combined concrete cone and pullout failure is the controlling failure mode as described by TR029. All other failure modes must be considered and different reduction factors may apply.
2. Tabulated values are based on a group of 2 anchors with the geometry defined by "S" and "S<sub>cr,Np</sub>" but without close edge considerations.
3. Anchors with geometry different to that defined in the above table must be considered separately and the tabulated values must not be used.
4. Interpolation is allowed.
5. Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.
6. Anchor spacing distances must exceed or be equal to the minimum anchor spacing (S<sub>min</sub>) as defined in the ETA.

1. Tabulated values are only applicable for instances where combined concrete cone and pullout failure is the controlling failure mode as described by TR029. All other failure modes must be considered and different reduction factors may apply.
2. Tabulated values are based on a single anchor with a single close edge. Tabulated values must not be used if multiple close edges exist.
3. Anchors with geometry different to that defined in the above table must be considered separately and the tabulated values must not be used.
4. Interpolation is allowed.
5. Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.
6. Close edge distances must exceed or be equal to the minimum close edge distance (C<sub>min</sub>) as defined in the ETA.

## USING SIKA ANCHORFIX® -2+ ARCTIC WITH REINFORCING BARS

Combined pullout and concrete cone failure in non-cracked concrete C20/25

Size	Ø8mm	Ø10m	Ø12m	Ø16m	Ø20m	Ø25m	Ø32m		
Characteristic bond resistance in non-cracked concrete									
Characteristic bond resistance dry/wet concrete	$\tau_{RK}$	[N/mm <sup>2</sup> ]	12	10	10	9.0	9.0	9.0	5.5
Partial safety factor	$\gamma_{Mc}$	[-]	1.8						

# TENSION LOAD CALCULATIONS FOR COMBINED CONCRETE CONE & PULLOUT FAILURE AT VARIOUS EMBEDMENT DEPTHS

using reinforcing bars in dry / wet, uncracked, C20/25 concrete. Temperature range -40°C to +80°C.

Property	Symbol	Unit	Anchor Size						
			Ø8mm	Ø10m m	Ø12m m	Ø16m m	Ø20m m	Ø25m m	Ø32m m
Effective Embedment Depth = 8d	$h_{ef}$	mm	64	80	96	128	160	200	256
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	19.30	25.13	36.19	57.91	90.48	141.37	141.55
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Effective Embedment Depth = 10d	$h_{ef}$	mm	80	100	120	160	200	250	320
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	24.13	31.42	45.24	72.38	113.10	176.71	176.93
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Effective Embedment Depth = STD	$h_{ef}$	mm	80	90	110	128	170	210	300
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	24.13	28.27	41.47	57.91	96.13	148.44	165.88
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Effective Embedment Depth = 12d	$h_{ef}$	mm	96	120	144	192	240	300	384
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	28.95	37.70	54.29	86.86	135.72	212.06	212.32
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Effective Embedment Depth = 14d	$h_{ef}$	mm	112	140	168	224	280	350	448
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	33.78	43.98	63.33	101.34	158.34	247.40	247.71
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Effective Embedment Depth = 16d	$h_{ef}$	mm	128	160	192	256	320	400	512
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	38.60	50.27	72.38	115.81	180.96	282.74	283.10
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Effective Embedment Depth = 18d	$h_{ef}$	mm	144	180	216	288	360	450	576
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	43.43	56.55	81.43	130.29	203.58	318.09	318.48
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Effective Embedment Depth = 20d	$h_{ef}$	mm	160	200	240	320	400	500	640
Characteristic Load (Combined Concrete Cone & Pullout Failure)	$N_{Rk,p}^0$	kN	48.25	62.83	90.48	144.76	226.19	353.43	353.87
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80	1.80	1.80

<sup>1</sup> Characteristic loads are valid for combined concrete cone and pullout failure as defined by TR029 only. All other failure modes, including steel failure, detailed in TR029 as well as including combined effects of tension and shear, must be considered in accordance with TR029.

<sup>2</sup> Characteristic loads are valid for single anchors without close edge, anchor spacing or eccentric loading considerations.

<sup>3</sup> Tabulated values are valid for temperature range -40°C to +80°C (Max LTT = +50°C; Max STT = +80°C).

<sup>4</sup> Tabulated values are only valid for the installation conditions stated. Other conditions, such as different temperature ranges, may affect the performance of the product.

<sup>5</sup> Long term temperatures are those that remain roughly constant over prolonged periods. Short term temperatures occur over brief intervals, eg: diurnal cycling.

<sup>6</sup> The compressive strength of the concrete ( $f_{ck,cube}$ ) is assumed to be 25 N/mm<sup>2</sup> for C20/25 concrete.

<sup>7</sup> Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.

# TENSION LOAD CALCULATIONS FOR COMBINED CONCRETE CONE & PULLOUT FAILURE AT 8D EMBEDMENT DEPTH

using reinforcing bars in dry / wet, uncracked, C20/25 concrete. Temperature range -40°C to +80°C.

Property	Symbol	Unit	Anchor Size						
			Ø8mm	Ø10m	Ø12m	Ø16m	Ø20m	Ø25m	Ø32m
Nominal Anchor Diameter	d	mm	8	10	12	16	20	25	32
Characteristic Bond Strength	$\tau_{Rk}$	N/mm <sup>2</sup>	12.00	10.00	10.00	9.00	9.00	9.00	5.50
Effective Embedment Depth	$h_{ef}$	mm	64	80	96	128	160	200	256
Characteristic Load (Combined Concrete Cone and Pullout Failure)	$N_{Rk,p}^0$	kN	19.30	25.13	36.19	57.91	90.48	141.37	141.55
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Characteristic Anchor Spacing (Splitting Failure)	$S_{cr,sp}$	mm	192	240	288	384	480	600	768
Characteristic Edge Distance (Splitting Failure)	$C_{cr,sp}$	mm	96	120	144	192	240	300	384
Characteristic Anchor Spacing (Combined Concrete Cone and Pullout Failure)	$S_{cr,Np}$	mm	192	231	277	351	438	548	548
Characteristic Edge Distance (Combined Concrete Cone and Pullout Failure)	$C_{cr,Np}$	mm	96	115	139	175	219	274	274

<sup>1</sup> Characteristic loads are valid for combined concrete cone and pullout failure as defined by TR029 only. All other failure modes, including steel failure, detailed in TR029 as well as including combined effects of tension and shear, must be considered in accordance with TR029.

<sup>2</sup> Characteristic loads are valid for single anchors without close edge, anchor spacing or eccentric loading considerations.

<sup>3</sup> Tabulated values are valid for temperature range -40°C to +80°C (Max LTT = +50°C; Max STT = +80°C).

<sup>4</sup> Tabulated values are only valid for the installation conditions stated. Other conditions, such as different temperature ranges, may affect the performance of the product.

<sup>5</sup> Long term temperatures are those that remain roughly constant over prolonged periods. Short term temperatures occur over brief intervals, eg: diurnal cycling.

<sup>6</sup> The compressive strength of the concrete ( $f_{ck,cube}$ ) is assumed to be 25 N/mm<sup>2</sup> for C20/25 concrete.

<sup>7</sup> Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.

Reduction factors for close edge:  
Combined concrete cone and pullout failure

Close Edge Distance, C (mm)	Anchor Size	Anchor Size						
		Ø8mm	Ø10m	Ø12m	Ø16m	Ø20m	Ø25m	Ø32m
35		0.55						
40		0.58	0.54					
50		0.65	0.59	0.55				
60		0.72	0.65	0.59				
65		0.76	0.68	0.62	0.56			
70		0.79	0.71	0.64	0.57			
80		0.87	0.77	0.69	0.61	0.55		
90		0.95	0.83	0.74	0.65	0.58		
96		N/R	0.87	0.77	0.67	0.60		
100			0.90	0.79	0.68	0.61	0.55	
115			N/R	0.87	0.74	0.65	0.59	
120				0.90	0.76	0.67	0.60	
130				0.95	0.80	0.70	0.62	0.62
139				N/R	0.84	0.73	0.64	0.64
140					0.85	0.73	0.64	0.64
150					0.89	0.76	0.67	0.67
160					0.93	0.80	0.69	0.69
170					0.98	0.83	0.72	0.72
175					N/R	0.85	0.73	0.73
180						0.86	0.74	0.74
190						0.90	0.77	0.77
200						0.93	0.80	0.79
219						N/R	0.85	0.85
240							0.90	0.90
260							0.96	0.96
270							0.99	0.99
274							N/R	N/R

1. Tabulated values are only applicable for instances where combined concrete cone and pullout failure is the controlling failure mode as described by TR029. All other failure modes must be considered and different reduction factors may apply.
2. Tabulated values are based on a single anchor with a single close edge. Tabulated values must not be used if multiple close edges exist.
3. Anchors with geometry different to that defined in the above table must be considered separately and the tabulated values must not be used.
4. Interpolation is allowed.
5. Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.
6. Close edge distances must exceed or be equal to the minimum close edge distance ( $C_{min}$ ) as defined in the ETA.

Reduction factors for anchor spacing:  
Combined concrete cone and pullout failure

Anchor Spacing Distance, S (mm)	Anchor Size	Anchor Size						
		Ø8mm	Ø10m	Ø12m	Ø16m	Ø20m	Ø25m	Ø32m
35		0.64						
40		0.65	0.65					
50		0.67	0.66	0.64				
60		0.70	0.68	0.65				
65		0.71	0.69	0.66	0.63			
70		0.72	0.70	0.67	0.64			
80		0.74	0.72	0.69	0.65	0.61		
90		0.77	0.74	0.70	0.67	0.62		
100		0.79	0.76	0.72	0.68	0.64	0.59	
120		0.84	0.80	0.75	0.70	0.66	0.61	
130		0.86	0.82	0.77	0.72	0.67	0.62	0.68
140		0.88	0.83	0.78	0.73	0.68	0.63	0.68
160		0.93	0.87	0.81	0.76	0.70	0.65	0.70
180		0.97	0.91	0.85	0.78	0.72	0.67	0.71
192		N/R	0.93	0.87	0.80	0.74	0.68	0.72
200			0.94	0.88	0.81	0.74	0.68	0.73
220			0.98	0.91	0.83	0.77	0.70	0.75
231			N/R	0.93	0.85	0.78	0.71	0.76
240				0.94	0.86	0.79	0.72	0.76
260				0.97	0.89	0.81	0.74	0.78
277				N/R	0.91	0.83	0.75	0.79
280					0.91	0.83	0.76	0.79
300					0.94	0.85	0.77	0.81
351					N/R	0.91	0.82	0.85
400						0.96	0.87	0.89
438						N/R	0.90	0.92
450							0.91	0.93
500							0.96	0.96
548							N/R	N/R

1. Tabulated values are only applicable for instances where combined concrete cone and pullout failure is the controlling failure mode as described by TR029. All other failure modes must be considered and different reduction factors may apply.
2. Tabulated values are based on a group of 2 anchors with the geometry defined by "S" and " $S_{c,lp}$ " but without close edge considerations.
3. Anchors with geometry different to that defined in the above table must be considered separately and the tabulated values must not be used.
4. Interpolation is allowed.
5. Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.
6. Anchor spacing distances must exceed or be equal to the minimum anchor spacing ( $S_{min}$ ) as defined in the ETA.

# TENSION LOAD CALCULATIONS FOR COMBINED CONCRETE CONE & PULLOUT FAILURE AT STD EMBEDMENT DEPTH

using reinforcing bars in dry / wet, uncracked, C20/25 concrete. Temperature range -40°C to +80°C.

Property	Symbol	Unit	Anchor Size						
			Ø8mm	Ø10m	Ø12m	Ø16m	Ø20m	Ø25m	Ø32m
Nominal Anchor Diameter	d	mm	8	10	12	16	20	25	32
Characteristic Bond Strength	$\tau_{Rk}$	N/mm <sup>2</sup>	12.00	10.00	10.00	9.00	9.00	9.00	5.50
Effective Embedment Depth	$h_{ef}$	mm	80	90	110	128	170	210	300
Characteristic Load (Combined Concrete Cone and Pullout Failure)	$N_{Rk,p}^0$	kN	24.13	28.27	41.47	57.91	96.13	148.44	165.88
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Characteristic Anchor Spacing (Splitting Failure)	$S_{cr,sp}$	mm	240	270	330	384	510	630	900
Characteristic Edge Distance (Splitting Failure)	$C_{cr,sp}$	mm	120	135	165	192	255	315	450
Characteristic Anchor Spacing (Combined Concrete Cone and Pullout Failure)	$S_{cr,Np}$	mm	202	231	277	351	438	548	548
Characteristic Edge Distance (Combined Concrete Cone and Pullout Failure)	$C_{cr,Np}$	mm	101	115	139	175	219	274	274

<sup>1</sup> Characteristic loads are valid for combined concrete cone and pullout failure as defined by TR029 only. All other failure modes, including steel failure, detailed in TR029 as well as including combined effects of tension and shear, must be considered in accordance with TR029.

<sup>2</sup> Characteristic loads are valid for single anchors without close edge, anchor spacing or eccentric loading considerations.

<sup>3</sup> Tabulated values are valid for temperature range -40°C to +80°C (Max LTT = +50°C; Max STT = +80°C).

<sup>4</sup> Tabulated values are only valid for the installation conditions stated. Other conditions, such as different temperature ranges, may affect the performance of the product.

<sup>5</sup> Long term temperatures are those that remain roughly constant over prolonged periods. Short term temperatures occur over brief intervals, eg: diurnal cycling.

<sup>6</sup> The compressive strength of the concrete ( $f_{ck,cube}$ ) is assumed to be 25 N/mm<sup>2</sup> for C20/25 concrete.

<sup>7</sup> Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.

Reduction factors for close edge:  
Combined concrete cone and pullout failure

	Anchor Size							
		Ø8mm	Ø10m	Ø12m	Ø16m	Ø20m	Ø25m	Ø32m
Close Edge Distance, C (mm)	40	0.57						
	45	0.60	0.57					
	50	0.63	0.59					
	55	0.67	0.62	0.57				
	60	0.70	0.65	0.59				
	65	0.73	0.68	0.62	0.56			
	70	0.77	0.71	0.64	0.57			
	80	0.84	0.77	0.69	0.61			
	85	0.88	0.80	0.71	0.63	0.57		
	90	0.91	0.83	0.74	0.65	0.58		
	101	N/R	0.90	0.79	0.69	0.61		
	105		0.93	0.82	0.70	0.62	0.56	
	110		0.96	0.84	0.72	0.64	0.58	
	115		N/R	0.87	0.74	0.65	0.59	
	120			0.90	0.76	0.67	0.60	
	130			0.95	0.80	0.70	0.62	
	139			N/R	0.84	0.73	0.64	
	140				0.85	0.73	0.64	
	150				0.89	0.76	0.67	0.67
	160				0.93	0.80	0.69	0.69
	170				0.98	0.83	0.72	0.72
	175				N/R	0.85	0.73	0.73
	180					0.86	0.74	0.74
	190					0.90	0.77	0.77
	200					0.93	0.80	0.79
	220					N/R	0.85	0.85
	240						0.90	0.90
	260						0.96	0.96
274						N/R	N/R	

Reduction factors for anchor spacing:  
Combined concrete cone and pullout failure

	Anchor Size							
		Ø8mm	Ø10m	Ø12m	Ø16m	Ø20m	Ø25m	Ø32m
Anchor Spacing Distance, S (mm)	40	0.66						
	45	0.67	0.66					
	50	0.68	0.67					
	55	0.69	0.68	0.65				
	60	0.70	0.69	0.66				
	65	0.71	0.70	0.67	0.63			
	70	0.72	0.71	0.68	0.64			
	80	0.75	0.73	0.69	0.65			
	85	0.76	0.74	0.70	0.66	0.62		
	90	0.77	0.75	0.71	0.67	0.63		
	100	0.79	0.76	0.72	0.68	0.64		
	105	0.80	0.77	0.73	0.69	0.65	0.60	
	125	0.84	0.81	0.76	0.71	0.67	0.62	
	150	0.89	0.86	0.80	0.74	0.69	0.64	0.70
	175	0.94	0.90	0.84	0.78	0.72	0.66	0.72
	202	N/R	0.95	0.89	0.81	0.75	0.69	0.74
	225		0.99	0.92	0.84	0.77	0.71	0.76
	231		N/R	0.93	0.85	0.78	0.72	0.76
	250			0.96	0.87	0.80	0.73	0.78
	277			N/R	0.91	0.83	0.76	0.80
	300				0.94	0.85	0.78	0.81
	351				N/R	0.91	0.82	0.85
	400					0.96	0.87	0.89
	438					N/R	0.90	0.92
	450						0.91	0.93
	500						0.96	0.96
	548						N/R	N/R

1. Tabulated values are only applicable for instances where combined concrete cone and pullout failure is the controlling failure mode as described by TR029. All other failure modes must be considered and different reduction factors may apply.
2. Tabulated values are based on a single anchor with a single close edge. Tabulated values must not be used if multiple close edges exist.
3. Anchors with geometry different to that defined in the above table must be considered separately and the tabulated values must not be used.
4. Interpolation is allowed.
5. Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.
6. Close edge distances must exceed or be equal to the minimum close edge distance ( $C_{min}$ ) as defined in the ETA.

1. Tabulated values are only applicable for instances where combined concrete cone and pullout failure is the controlling failure mode as described by TR029. All other failure modes must be considered and different reduction factors may apply.
2. Tabulated values are based on a group of 2 anchors with the geometry defined by "S" and " $S_{cr,Np}$ " but without close edge considerations.
3. Anchors with geometry different to that defined in the above table must be considered separately and the tabulated values must not be used.
4. Interpolation is allowed.
5. Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.
6. Anchor spacing distances must exceed or be equal to the minimum anchor spacing ( $S_{min}$ ) as defined in the ETA.



# TENSION LOAD CALCULATIONS FOR COMBINED CONCRETE CONE & PULLOUT FAILURE AT 20D EMBEDMENT DEPTH

using reinforcing bars in dry / wet, uncracked, C20/25 concrete. Temperature range -40°C to +80°C.

Property	Symbol	Unit	Anchor Size						
			Ø8mm	Ø10m	Ø12m	Ø16m	Ø20m	Ø25m	Ø32m
Nominal Anchor Diameter	d	mm	8	10	12	16	20	25	32
Characteristic Bond Strength	$\tau_{Rk}$	N/mm <sup>2</sup>	12.00	10.00	10.00	9.00	9.00	9.00	5.50
Effective Embedment Depth	$h_{ef}$	mm	160	200	240	320	400	500	640
Characteristic Load (Combined Concrete Cone and Pullout Failure)	$N_{Rk,p}^0$	kN	48.25	62.83	90.48	144.76	226.19	353.43	353.87
Partial Safety Factor	$\gamma_{Mc}$	-	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Characteristic Anchor Spacing (Splitting Failure)	$S_{cr,sp}$	mm	480	600	720	960	1200	1500	1920
Characteristic Edge Distance (Splitting Failure)	$C_{cr,sp}$	mm	240	300	360	480	600	750	960
Characteristic Anchor Spacing (Combined Concrete Cone and Pullout Failure)	$S_{cr,Np}$	mm	202	231	277	351	438	548	548
Characteristic Edge Distance (Combined Concrete Cone and Pullout Failure)	$C_{cr,Np}$	mm	101	115	139	175	219	274	274

<sup>1.</sup> Characteristic loads are valid for combined concrete cone and pullout failure as defined by TR029 only. All other failure modes, including steel failure, detailed in TR029 as well as including combined effects of tension and shear, must be considered in accordance with TR029.

<sup>2.</sup> Characteristic loads are valid for single anchors without close edge, anchor spacing or eccentric loading considerations.

<sup>3.</sup> Tabulated values are valid for temperature range -40°C to +80°C (Max LTT = +50°C; Max STT = +80°C).

<sup>4.</sup> Tabulated values are only valid for the installation conditions stated. Other conditions, such as different temperature ranges, may affect the performance of the product.

<sup>5.</sup> Long term temperatures are those that remain roughly constant over prolonged periods. Short term temperatures occur over brief intervals, eg: diurnal cycling.

<sup>6.</sup> The compressive strength of the concrete ( $f_{ck,cube}$ ) is assumed to be 25 N/mm<sup>2</sup> for C20/25 concrete.

<sup>7.</sup> Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.

Reduction factors for close edge:  
Combined concrete cone and pullout failure

Close Edge Distance, C (mm)	Anchor Size	Anchor Size						
		Ø8mm	Ø10m	Ø12m	Ø16m	Ø20m	Ø25m	Ø32m
80	0.84							
90	0.91							
100	0.99	0.90						
101	1.00	0.90						
110		0.96						
115		N/R						
120			0.90					
130			0.95					
139			N/R					
140								
150								
160				0.93				
170				0.98				
175				N/R				
180								
190								
200					0.93			
219					N/R			
220								
240								
250						0.93		
260						0.96		
274						N/R		
280								
300								
320								N/R

1. Tabulated values are only applicable for instances where combined concrete cone and pullout failure is the controlling failure mode as described by TR029. All other failure modes must be considered and different reduction factors may apply.
2. Tabulated values are based on a single anchor with a single close edge. Tabulated values must not be used if multiple close edges exist.
3. Anchors with geometry different to that defined in the above table must be considered separately and the tabulated values must not be used.
4. Interpolation is allowed.
5. Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.
6. Close edge distances must exceed or be equal to the minimum close edge distance ( $C_{min}$ ) as defined in the ETA.

Reduction factors for anchor spacing:  
Combined concrete cone and pullout failure

Anchor Spacing Distance, S (mm)	Anchor Size	Anchor Size						
		Ø8mm	Ø10m	Ø12m	Ø16m	Ø20m	Ø25m	Ø32m
80	0.77							
90	0.79							
100	0.81	0.79						
120	0.85	0.82	0.78					
140	0.89	0.86	0.81					
160	0.92	0.89	0.84	0.79				
180	0.96	0.92	0.87	0.81				
200	0.99	0.95	0.90	0.84	0.78			
202	N/R	0.96	0.90	0.84	0.79			
225		0.99	0.93	0.86	0.81			
231		N/R	0.94	0.87	0.81			
250			0.96	0.89	0.83	0.78		
277			N/R	0.92	0.86	0.80		
300				0.95	0.88	0.82		
320				0.97	0.90	0.83	0.85	
325				0.97	0.90	0.83	0.85	
351				N/R	0.92	0.85	0.87	
375					0.94	0.87	0.89	
400					0.97	0.89	0.90	
438					N/R	0.92	0.93	
450						0.93	0.94	
500						0.97	0.97	
548						N/R	N/R	

1. Tabulated values are only applicable for instances where combined concrete cone and pullout failure is the controlling failure mode as described by TR029. All other failure modes must be considered and different reduction factors may apply.
2. Tabulated values are based on a group of 2 anchors with the geometry defined by "S" and "S<sub>cr,sp</sub>" but without close edge considerations.
3. Anchors with geometry different to that defined in the above table must be considered separately and the tabulated values must not be used.
4. Interpolation is allowed.
5. Tabulated values assume that the geometry of the anchor(s) and concrete member is sufficient to avoid splitting failure.
6. Anchor spacing distances must exceed or be equal to the minimum anchor spacing ( $S_{min}$ ) as defined in the ETA.

## IMPORTANT NOTES

### Use in Porous Substrates

This bonded anchor is not intended for use as a cosmetic or decorative product. When anchoring into porous or reconstituted stone it is recommended that technical assistance is sought. Due to the nature of the product, migration of the monomer in the resin may cause staining in certain materials. If you are still uncertain, it is advisable to test the resin by applying it in a small, discrete area and testing before using the resin on the project.

### Important Note

Whilst all reasonable care is taken in compiling technical data on the Company's products, all recommendations or suggestions regarding the use of such products are made without guarantee, since the conditions of use are beyond the control of the Company. It is the customer's responsibility to satisfy himself that each product is fit for the purpose for which he intends to use it, that the actual conditions of use are suitable and that, in the light of our continual research and development programme the information relating to each product has not been superseded.